

## **METHOD AND APPARATUS FOR STARTING UP AND MAINTAINING OF MULTIPLE NETWORKED COMPUTING SYSTEMS**

### **BACKGROUND OF THE INVENTION**

#### **Technical Field:**

[0001] The present invention relates in general to managing computing systems. More particularly, the present invention relates to starting up and maintaining computing systems. Still more particularly, the present invention relates to starting up and maintaining of multiple networked computing systems by using a common start-up program located within a computer network.

#### **Description of the Related Art:**

[0002] The process of starting up a computer from a stopped or powered off condition is called "booting." The boot process begins when the computer is turned on. During the boot process, the computer's processor begins to execute a small code segment that resides someplace on the computer in memory causing the computer to retrieve a start-up program at a location directed by the executing code segment. The computer could retrieve a start-up program from multiple sources including its own hard drive, a diskette, or externally. In the latter case, the computer can retrieve the start-up program via any of its input/output ports as directed by the executing code segment.

[0003] The computer's processor executes the start-up code once it has been retrieved. The start-up code instructions cause the computer to perform the steps of identifying and configuring the computer's devices, initializing the operating system, and starting the computer system processes. In the final step, the start-up code causes the computer to make the system ready for use.

**[0004]** In many settings such as offices, schools, and laboratories, individuals use computers that are networked together with access to a central server. When an individual boots a computer, the start-up code the computer uses to boot is typically located at the local computer. Typically, every computer model requires its own start-up code for its unique features and peripherals. Each time a system upgrade is performed each networked computer's start-up code must be modified by a process that is both time and labor intensive.

**[0005]** Therefore, there is a need in the industry for a method to more efficiently boot and maintain multiple networked computer systems by using a compact common start-up program located within a network.

## SUMMARY OF THE INVENTION

[0006] Sparse labor resources would be made available for more pressing tasks if all of the computers on a network could be upgraded by modifying one start-up code instead of a start-up code for each networked computer and if each user only had to wait for the driver programs his computer needed to boot. Start-up code, as discussed herein, is composed of two parts and the first and larger part is common start-up code that includes all instructions that cause each networked computer in a network to start-up all common components within each networked computer. In a network with multiple networked computers and a networked disk or other storage media, each of the multiple networked computers executes boot code instructions causing common start-up code to be retrieved from the same address on the networked media.

[0007] The second and smaller part of start-up code are unique driver programs for each networked computer including unique instructions required to cause start-up of unique devices for that networked computer. Each networked computer's unique driver programs are located at a different unique address on the networked media. Each networked computer executes instructions included in common start-up code causing a file containing its unique driver programs for its unique components to be retrieved from networked media.

[0008] By separating start-up code into two parts in this manner, the start-up procedure on each networked computer will thus be able to complete start-up just as if each networked computer had retrieved its own unique start-up code from the networked media. Since the largest part of start-up code is common start-up code that needs to be stored and upgraded in one instance for all networked computers, valuable memory and labor resources are conserved.

[0009] There are at least three ways that files including unique driver programs for each networked computer can be retrieved. One way is to embed addresses of unique

driver programs for each of the multiple networked computers in common start-up code. Once each networked computer executes common start-up code instructions causing the executing computer to be uniquely identified, additional common start-up code instructions are executed causing unique driver programs for the executing computer to be retrieved from the correct address on the networked media.

[0010] Another method for retrieving each networked computer's unique driver programs is for each networked computer to execute common start-up code instructions causing a file from the networked media containing the addresses of the unique driver programs for each networked computer on the system to be retrieved from networked media. Once each networked computer executes common start-up code instructions causing the executing computer to be uniquely identified, additional common start-up code instructions are executed causing the unique driver programs for the executing computer to be retrieved from the correct address on the networked media.

[0011] Yet another method for retrieving each networked computer's unique driver programs is to store the address of the unique driver programs in memory on each networked computer. Once each networked computer executes common start-up code instructions causing the address of the unique driver programs for the executing computer to be retrieved from the memory of the executing computer, additional common start-up code instructions are executed causing the unique driver programs for the executing computer to be retrieved from the correct address on the networked media.

[0012] The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed description.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

[0014] **FIG. 1** is a pictorial representation of a network which may be utilized to implement the method and apparatus of the present invention;

[0015] **FIG. 2** is a block diagram of a computer system representative of a computer system of the present invention;

[0016] **FIG. 3** is high-level logic flow diagram for booting multiple networked computers from the same disk when the address of unique driver programs is located within executing computer's memory;

[0017] **FIG. 4** is a high-level logic flow diagram for determining the correct address of unique driver programs from the common start-up code; and

[0018] **FIG. 5** is a high-level logic flow diagram for determining the correct address of unique driver programs from a file on networked media.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0019] With reference now to the figures and in particular with **FIG. 1**, there is depicted a pictorial representation of a network which may be utilized to implement the method and apparatus of the present invention.

[0020] As illustrated, a network **100** is a distributed network to which multiple computers and storage media are electronically coupled together. Computers **110**, **120**, **130**, **140**, **150**, and storage media **160** are interconnected to each other via network **100**. The details of the interconnection of computers within network **100** are thought to be well within the knowledge of one having ordinary skill in the art and consequently, forms no part of the present disclosure. One of ordinary skill in the art would also know that numerous other devices such as printers, scanners, and other computers could additionally be interconnected within network **100**.

[0021] Referring now to **FIG. 2**, there is depicted a block diagram of a computer system representative of the preferred embodiment of the present invention. A computer system **200** includes a processor **290** coupled via a cache **210** to a system bus **230**. Connected to system bus **230** are conventional memory devices including a system memory **240**, typically a random access memory device, and a set of nonvolatile read-only memory (ROM) and/or erasable, electrically programmable read only memory (EEPROM) devices (not shown). Also attached to system bus **230** are a nonvolatile storage **250** such as a hard disk drive and a set of user input/output devices **220**. One of ordinary skill in the art would know that many other devices could be attached to system bus **230** such as CD-R/W's, DVD-R's, floppy disk systems, and tape back up systems. The remaining details of construction and of operation of computer system **200** are well known in the relevant art, and only so much of the operation as is required for an understanding of the present invention will be described herein.

[0022] One of skill in the art will recognize that the steps and order of the steps in the high-level flow diagrams depicted in **FIG. 3**, **FIG. 4**, and **FIG. 5** are only representative of one embodiment of the present invention.

[0023] Referencing now to **FIG. 3**, there is depicted a high-level flow diagram for booting multiple networked computers from the same disk. After starting as depicted in **300**, the boot code located in executing networked computer's memory is executed as shown in block **310**. Common start-up code is then retrieved from networked media, as shown in block **320**. Boot code passes control to common start-up code as shown in block **330**, and common start-up code is then executed as depicted in block **340**. Address (AD) is retrieved from the executing networked computer's memory, as shown in block **345**. One with skill in the art will recognize that various other methods of determining AD may be used and can replace block **345**. Unique driver programs for executing networked computer are retrieved from networked media at a location pointed to by AD, as depicted in block **350**, and unique driver programs are executed, as shown in block **360**. One of skill in the art will recognize that unique driver programs may be retrieved from the executing computer itself or from various other media sources. Finally, the system is brought up and made available for use as depicted in block **370**.

[0024] **FIG. 4** is a high-level flow diagram depicting one of various other ways for determining the correct address of unique driver codes for an executing computer. In this case it is retrieving addresses that have been embedded in common start-up code. This high-level flow diagram would replace block **345** of **FIG. 3**. After starting as shown in block **400**, Executing computer's identification (CID) is retrieved from its memory, as shown in block **410**. As shown in the next block **420** a pointer is initialized to the first location of computer identification (ID) embedded in common start-up code. A determination is made as to whether CID is equal to ID as shown in **430**, if they are not, ID is incremented by one, as shown in block **440** and compared

to ID in block **430** until a match is found. When ID matches CID, address (AD) of unique driver programs is retrieved at location ID, as shown in block **450**.

[0025] Referring now to **FIG. 5**, there is depicted a high-level flow diagram for determining the correct address of unique driver programs from a file on networked media. This high level flow chart would replace block **345** of **FIG. 3**. After starting, which is depicted in block **500**, a file (FILE) containing unique driver program addresses for each networked computer is read from media as shown in block **510**. Executing computer's identification (CID) is retrieved from its memory, as suggested by block **520**. As shown in block **530**, a pointer is initialized to the first location of computer identification (ID) in FILE. As the decision block **540** shows, CID is next compared to ID to determine if they are equal, if they are not, ID is incremented by one, as shown in block **550**, and compared to ID as shown in block **540** until a match is found. When ID matches CID, address (AD) of unique driver programs is retrieved at location ID, as block **560** suggests.

[0026] In this manner, common start-up code is stored once for all networked computers to access. The prior art required either a copy start-up code for each individual networked computer or start-up code that includes every possible combination of features and devices that can be implemented on a networked computer. The method and system of the current allows faster start-up times for computer users and more efficient labor and memory resource allocation.

[0027] While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.